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MEDICAL RESEARCH[1]

I HAVE said that I would not plunge with you this evening into the ocean of science; but if you are a little tired of hearing of the dependence of medicine upon science you may find refreshment or diversion in contemplating the debts of science to medicine. My old medical friend Mr. Meade, of Bradford, was almost the only man who knew much about flies at the time when Manson and Ross began to watch these little pests. Without medicine, bacteriology and the study of the cell would have made slow way; yet it is the study of the cells of bacteria, of algæ, of protozoa—not of mandarins—which has brought us nearer to the secret of life. On the wonderful world of the cell I have spoken before. Professor Hopkins has lately described to us the almost incredible coexistence in it of different constitutions, phases, and events; though every change in any phase affects the equilibrium of the whole cell system. And every one of these is essential to the whole; "so long, for example, as a liver cell remains alive its glycogen constituent can not be wholly removed." If a cell be so ground up as to become more homogeneous, its reactions fall out at haphazard, and the cell dies by mutual destruction of its parts. This process of nature is illustrated on a mighty scale to-day in the disintegration of the Russian social organism.

Some of the apparently simple cell constituents, hæmoglobin for instance, are incredibly complex; this substance is specific for every kind of animal; in allied species, if concordant, it is not identical. Of the chromosomes I need say nothing; except to hope that as X rays have analyzed crystalline structure some such rays may analyze nuclear constitutions.

By another way, medicine has promoted research on organic syntheses; and conversely on

[1] From the address of the president of the British Medical Association at the Cambridge meeting.

the reduction of foods into the more complex amino-acids before being rewoven into the tissues of life. From medicine began our recognition of the plowman as the first parent of animals and man, and our fuller knowledge of "the green plant as the fundamental capitalist."

> Herbs gladly cure our flesh, because that they
> Finde their acquaintance there.

In the dark soil the nitrifying bacteria live on inorganic matter; so in the light some inorganic colloidal systems can build up formaldehyde (B. Moore). Medicine has introduced the chemist to the domain of the hormones and chalones, themselves also bodies of the simpler chemical constitution—some crystallizable, all able to resist prolonged boiling—blended into a wonderful physico-chemical coordinating system, secretly at work all the time under the diagrams of the innocent neurologist. We may suppose indeed that every active tissue of the body, or every cell, even of bone and skin, or of the substrate of mind itself, like every individual of a social organism, contributes some element to the organic whole, some inward production necessary for growths, or for signals.[2] There may be a world of pathological (alien or perverted) hormones as yet unexplored. May the dive inwards of epithelial cells in cancer be due to some inversion of chemotaxis, possibly under the influence of an alien (parasitic?) enzyme? Within the body then all parts are the "environment" of each—so that we have both an inner and an outer "climate," an aspect of the microcosm not to be forgotten in the field of mental disease. Thus it is that "Each part may call the farthest, brother." And these agents have a field of action far beyond the body, as we see for example in the sexual hormones. If there be a "migration hormone" its sphere is the world.

Again, is it not largely by medicine that the study of enzymes has thrown light upon the operations of catalysis which, like the rollers under a log or, as we now think, more by engagement and disengagement like rack and pinion, is incessantly forwarding, by various intermediate series, and by reversible actions at points of concentrative equilibrium, the processes of nature? The vitamines may be of this kind, agents which have upset our cruder calculations of nutritive values; for instance, in the feeding of children, we no longer take cane sugar to be the vital equivalent of lactose, nor margarine of butter; not all the nitrogen of nutrition is included in protein, nor are phospho- and amino-lipins, nucleic acid, amino-acids, and so on, mutually convertible in the body. We must admit that the fundamental principles of nutrition have yet to be redetermined. Moreover the war has forced us to remember the mutual dependence of food kinds; that of course fats and carbohydrates are not wholly independent or equivalent; the carbohydrates can not make up any great lack of fats, nor can oxidation of fats proceed in the absence of carbohydrates.

Another system of balances in the body, as of the reciprocal functions of lung and kidney, is more obviously chemical. Medicine has taught us how the lung deals with the CO_2 ions, the kidneys with sundry other acids, so that the blood reaction is maintained with extreme nicety; and that other systems—for example, the vasomotor—are probably little less sensitive, and that there are other subtle causes of anoxaemia besides the cardio-pulmonary (Haldane); so that in medicine it is of the first importance that in all abnormal conditions the oxygen tension of bloods should be systematically ascertained and compared. The hydrogen ion concentration is consistently higher upon flesh diet, lower upon vegetable diet; but I think we have not yet learned to discriminate so subtly as Charles Kean who is said to have chosen his viands according to the parts he had to play—pork for tyrants, beef for murderers, mutton for lovers.

Next after the origin of life itself, from ancient times to this day no enigma has attracted and baffled the curious mind of man more than that of living "form." Many of our keenest minds—Haldane, D'Arcy Thompson, Osborn, Dendy, McBride, I mention a few

[2] Mathews, "Physiological Chemistry," second edition, p. 835.

names as they occur to me—are still chasing this will-o'-the-wisp; and moth-like I can not but flutter after them. Of the nitrifying bacteria which assimilate inorganic matter, of the synthetic amines of animal nutrition, of the properties of colloids, I have spoken already to-day and last year; but "how," says Dr. Haldane, "is constant form maintained amid the continuous changes of our changing matter?" and—I may add—of variations of parts. Is "form" something after the manner of seal, which is impressed upon matter? or is it, in Aristotle's sense, a kind of soul (entelechy) which shapes the potential, or capacity, into integral being? Here we hover between metaphysical or ontological concepts and natural law, or the properties of matter. A few years ago all notion of self-shaping was dismissed, and the animal regarded merely as a diagram of incident forces; to-day there is some harkback, if not to moulding entities, at any rate to some phases which partake both of germ and matrix. We had been taught that for development functional stimuli were all that was necessary; for instance, that the heart grew, even beyond the normal, only in response to demand for its work and by increased supply of blood to its tissues. But is there any functional adaptation from within? If a limb be not used the bone will still grow more or less; but why does the bone grow *round?* And an eye will grow, from a germ of it, in the dark (Loeb). Is there such a property in living matter as "functional adaptation"? Is function in its effect upon form adaptive or purposive? Is environment met by adaptive variation—for instance in a germ cell? Again, if so, can specific properties of such a kind be acquired? Biologists seem to have proved that evolution of form may go on continuously when environmental change is suspended, or remains constant; and conversely that environmental change does not necessarily induce evolution. On a broad view, says Professor Osborn,[3] during the infinite variety of the widely diverging forms of the Mammalian period of the earth, the reptiles have shown very little change. We perceive that these questions arise in some contrast with the hypothesis of the selection of "chance" variations.

[3] Osborn, "Origin and Evolution of Life," p. 137.

On the other hand, we find reason to marvel at the constancy of bacterial species; humble and embryonic beings that we should not expect to have become fixed in their habits. Yet they and their enzymes are very exacting about it; as we find, for example, with the several enteric bacteria, or with the meningococcic or pneumococcic varieties, of which each has its own serous or agglutinin test, and is indifferent to the rest. And there is more still to be said: when the microbe finds itself in the host's body it may be wholly out of tune, or wholly in tune, with any or all cells that it approaches; in either case presumably nothing morbid would happen, perhaps, by a kind of zygosis, a benefit; morbid happenings would lie between this microbe and body cells within its range but not in tune with it. Now there seems to be reason to suppose that a microbe, on its approach to a body cell only just out of its range, may try this way and that to get a hitch on. If so, the microbe, at first innocuous, would become noxious. So on the other hand body cells may educate themselves to vibrate in harmony with a microbe before dissonant; or there may be mutual interchange and coadaptation. Such considerations arise out of many known phenomena at phase boundaries, of sympathetic vibrations, of acquired immunity, of new virulences, and so forth; the cells out of tune getting nearer and nearer into consonance with each other.

But, if things be so, surely we are face to face with a marvelous and far-reaching faculty, *the faculty of choice,* and this rising from the utter bottom of biology to the summit—formative faculty—"auto-determination," or, if you please, "mind." Can the microbe do as the retriever does when with a hare in his mouth he comes to a gate; he tries this way and that, then thrusts the hare under the gate, leaps over and pulls the hare through? So the microbe tries it on, this way or that, till it succeeds, by self-education in the school of experience—*Bildungstrieb.* This is far more —radically more—than *"élan vital";* not

merely energy but *choice*—plasticity driven to choose or fail; thus new devices are tried and new habits established. So likewise Dr. Topley has dwelt upon a microbe acquiring a capacity to bring about certain fermentations,[4] an ability, as he says, "to be regarded as something inherent in the organism itself." We may be reminded also of Professor Stanley Gardiner's "education" of his oysters—a very curious observation.

So far as I can think upon it there seems to be but one alternative hypothesis, but this does not cover so many phenomena. As I have said, if the vibrations of an alien cell are out of range of a certain body cell so as just to be indifferent but yet not far out of range, the vibrations of the one might induce like vibrations in the other, and meanwhile interference waves would arise in the field; thus disturbances—symptoms—would begin and continue until the two sets of waves should blend into unison; and this would mean acquired immunity. If a number of wag-at-the-wall clocks are hung near each other, in a calculable time they will get to swing in unison. But this hypothesis does not lead on, as does the trial and error hypothesis, to larger and larger gains. We see only a discord and a mode of requiescence; no line of development. What we apprehend is something more than orderliness of chemical reaction; that *cells are teachable;* a key to illimitable progress. Was not Coleridge right when he said

> For I had found
> That outward forms, the loftiest, still receive
> Their final influence from the Life within.

I am not for one moment forgetting that the physical modes of energy—adsorption, surface tension, and so forth—may count for much in these advances, arrests, immunities, and disintegrations. Adsorption, or other physical condition, may put up a block. How remarkable are the effects of anesthesia and palsy which may follow injections of sodium oxalate and magnesium sulphate, and of their quick removal by calcium salts; indeed the whole influence of calcium on metabolism—probably all of them surface (interface) actions, as of any radio-active element upon cell function.[5] Indeed, as in the relation of foodstuffs to amines, so in the physics of the cell we may discover a comparative accessibility and intelligibility of the processes of life—Poincaré's "*simplicité caché.*" It seems that God has more "respect to the measure and ease of the human understanding" than Boyle supposed.

Thus we are led to the thaumaturgic word "Research" which, for some of us, means remote and rather unreal speculations; for others the discovery of short cuts to making more money; for others again the ideal of pure knowledge. Research may be regarded as of two kinds, as natural observation and as artificial experiment; the one yielding more and more to the other as investigation penetrates from the more superficial to the deeper processes. Still, if we are to surprise and "capture wild nature in her secret paths," the two ways are strictly inseparable. Indeed the infinitely little does man more harm than the enormously great. War may bring with it some redemptive virtues; pestilence only raw superstitions. The advance of the last half century from the deadhouse pathology to more refined and penetrating methods we have witnessed in our time, and yet more intimate methods, those of biochemistry for instance, are being rapidly unfolded. Research, as it is working to-day, advances from fixed and measured bases; as observation it watches nature's march past; then as experiment it puts events to test under artificial conditions of separation or isolation, and measures their phases. But the laboratory can not, as nature does, contrive the unexpected; so we must "gear up our tiny machines to the vast wheel of nature," and try for a first roughing out of an idea or concept. If we are to select our facts to any considerable purpose as crucial, we must first have an idea in our minds; and for this a certain kind of imagination is needed, one of general concepts rather than of the concrete individualizing imagination of the artist. Thus there

[4] *Lancet*, May 22, 1920, where he quotes "Penfold and others."

[5] Gates and Meltzer, Rockf. St., Vol. XXV., and *Jour. of Physiol.*, February 20, 1920.

are two kinds of discoverers, whose comparative outlines we have not yet well discerned. Of scientific discovery Henri Poincaré gives an interesting appreciation; he says that discovery consists of three stages: the first stage is of laborious work at the problem on all sides; the next is not one of conscious occupation with the subject, but of unconscious cerebration, during which a promising hypothesis may unexpectedly arise in the mind; the third is deliberate verification and completion of form. Thus out of an unlimited number of possible combinations, and by many speculations, the discoverer at length divines the true one. In medicine this has been clearly the course of surgery, the side of medicine which is closer to nature.[6] The surgery of my young days was only too "observational"; the friendly fingers of curious colleagues were popped in and out of an operative incision with no apprehensions about "the infinitely little." Now the observer is sadly pushed aside; the ritual of surgery is become like the magic rites of old of which, if a point were dropped or a word changed, the virtue went out. But the rite could be done over again by the penitent; unluckily in surgical rites there is little room for repentances.

A new scheme of research into the origin of diseases, lately instituted at St. Andrews, claims our respectful attention. And may I be forgiven if here I pay a tribute to the rare devotion which inspired Sir James Mackenzie to forsake place and honor to follow after knowledge; indifferent whither he were led so long as truth was the leader. Sir James argues that the man in charge of the first deviations from health is the general practitioner; and that, if we are to detect diseases in their incipience, he must be the detective. One evening about the year 1879, when staying with Sir George Humphrey, he and I sat into the small hours devising a method by which we hoped to engage the general practitioner in scientific investigation. We secured the cooperation of this association and of many coadjutors;[7] Dr. Mahomed joined us as secretary. We hoped by gathering in large numbers of observations to eliminate error; and several series of questionnaires were distributed. Four volumes of reports were issued, under such editors as Humphry himself (on Old Age), Butlin (on Cancer), Whipham (on Rheumatic Fever), and Isambard Owen (on Intemperance). But the effort was premature; the data were too rickety, the reports too often irregular, dilatory and imperfect, and the reporters untrained in observation, punctuality and precision. As things are, few of our colleagues remember to let us know the issues of cases seen in consultation. We may hope now for better material and more accurate workers; not only so, but Sir James Mackenzie is developing another and no doubt better method; he is working with intense culture, on a small holding, and on a more intimate clinical plan.

In exploring a country the great watersheds and rivers are first laid down; to map out these and their valleys and tributaries is the first great work. These main features known, bearings are obtained whence to discover the contours of the hills, and to track up to the hidden sources of the streams. This is Sir James's mission—to track out the nascent rivulets, and with his divining rod to dig for the springs which feed the streams of disease.

Let us not suppose that this research will be but a matter of cleverness, sagacity, or even of intensive observation; nor flatter ourselves that because Mackenzie produced his great work on the *Pulse* while a general practitioner that he achieved this by ordinary clinical observation, however acute The progress of medicine must in large part be endogenous. While our pathologists in balloons were working on morbid phenomena without ever seeing a sick man, Mackenzie was bringing laboratory equipment, and exquisite laboratory methods, to the bedside. The polygraph, no easy instrument to handle even now, was the grandchild of the kymograph; and by it was

[6] See C. A., "Hist. Relations of Medicine and Survey."

[7] See Sir G. Humphry's presidential address at Cambridge, 1880.

proved again that science consists—as Plato said five centuries before Christ—*in measurement.* So in the St. Andrews research, not only have the initial warpings to be discovered, in their many ways and tides, but their volumes and their curves also to be measured as precisely as were those of the circulation by the polygraph. The physicist and the biochemist will need all their expertness in valuing molecular motions, analyzing secretions, recording blood tests and morphologies, and so forth, in their earliest and subtlest phases. For it is in molecular dynamics that the first deviations will arise; massive visible changes come later, and happily are now in large part calculated, or calculable. Mere observation—Nature's march past—will not count for much now; and as to family histories—well, they vary with each historian. And we practitioners will need a more searching discipline before we can occupy ourselves with problems so subtle.

The laws of inheritance must, I think, be sought out, at any rate at first, on animals; the generations of man are too long for comprehension; besides, something else seems lacking in this study of the genetics of man? . . . Is it a sense of humor?

And there is something more to be said. If light is to be thrown upon the generation of diseases in man it must be in part also by study in a far larger field; we must discover and compare the elements and phases of disease in animals and in plants. Sir James Paget, in his admirable address to the Pathological Section of this Association at Cambridge in 1880, reflected on the difficulties of human pathology because of its great complexity. He had "long and often felt that in this difficulty we might gain help from studying the consequences of injury and disease in the structure of plants" as less complex and under simpler conditions. To this field of pathology he devoted almost the whole of the address. A large part of my address in medicine to this association in Glasgow in 1888 was given to this appeal; it has found no response, hardly an echo. Yet what would anatomy be without comparative anatomy; language without comparative philology; anthropology, law, history, and even religion, without a like comprehension? Without an *Institute of Comparative Pathology* in Cambridge our range of vision and work is contracted. In the "Field Laboratories," it is true, Professors Woodhead and Nuttall, ably seconded by Dr. Stanley Griffith, are doing as much as lies in the power of a few individuals; but any such effort is puny beside the sphere of observation and research awaiting us. The comparative survey must cover the diseases of plants as well as of animals; of the lowest of living things up to the highest. The money loss year after year caused by the depredations and the diseases of animals and plants is enormous; and many of the methods of dealing with them—as with foot and mouth disease and swine fever—barbarous; if at present imperative.

Yet no one stirs, save to gyrate each in his own little circle. There is no integration, no organization of research, no cross light from school to school, no mutual enlightenment among investigators, no big outlook. The destruction by insects in forestry and agriculture alone in Great Britain is put at £30,000,000 per annum.[8] An Institute of Comparative Pathology in Cambridge with the endowment of professorial chairs and subordinate workers would cost no doubt a quarter of a million, a big sum; but what is this to the wastage of disease throughout the world of life!—to swine fever, diseases of cattle and horses, of crops, of forests, and so forth—utilitarian ends it is true, but to be followed on paths of discovery which would illuminate the whole field of nosology. Diseases are not "entities," nor even recurrent phases of independent events, but partial aspects of a universal series. The young graduates we have, many of them of great capacity; but every day we are losing them because they are not taken up at once into scientific teams; so they slacken, or drift into some other means of livelihood, and things muddle on as before. How blind we are!

T. Clifford Allbutt

[8] Mr. L. Scott, M.P., in the House of Commons.

THE RECENT EARTHQUAKES AT LOS ANGELES, CALIFORNIA

To the late Homer Hamlin more than any one else is due the credit for identifying the connection between certain local structural lines and the earthquakes which have affected the region about Los Angeles, Cal., during the past month. Hamlin's work, to the writer's knowledge, covered a period of over fifteen years prior to his death a few weeks ago. He, single handed, studied the cause of more than twenty earthquakes of varying degrees of intensity which have occurred in southern California during this period. Hamlin's conclusions, few of which unfortunately ever were put in print, were that the line of structural disturbance along which the epicentrums of most of the earthquakes were located, was that which extends from the Santa Monica Mountains, north of the Soldier's Home (about ten miles northwest of the business district of Los Angeles), in a southeasterly direction through the Baldwin Hills, Dominguez Hill, El Cerrito (near Long Beach), and thence easterly to the San Joaquin Hills northeast of Newport. The section along this line which has been the greatest offender is that extending several miles southeasterly from the Baldwin Hills. From a study of the intensity records, Hamlin was inclined to believe that the actual epicentrums were coincident in general with a fault which paralleled the anticline forming the Baldwin and Dominguez Hills, and extending along the northeast base of these hills. This may be true, but the writer is inclined to the theory that the actual crustal movements which produced the shocks took place along the Baldwin Hills-Dominguez Hill line, and that the maximum surface reaction might have been greater to the east of the hills because of the more unconsolidated character of the sediments in this direction.

In the shocks that occurred in the middle of June last, the greatest intensity was at Inglewood, a town lying ten miles southwest of Los Angeles, and only a very short distance southwest of the axis of the Baldwin Hills-Dominguez Hills fold. This would confirm the theory that the main line of disturbance is along the axis of this fold. In the shocks of July 16, the newspaper reports indicate only slight damage in Inglewood with the principal damage in the city of Los Angeles proper. These reports being true, it seems probable that this last tremor originated along the very pronounced fault, that extends east and west through the northwest residential district of Los Angeles, or along one of the lines of disturbance associated with this fault. It is this fault which marks the northern boundary of the oil-producing area of the Los Angeles city field, and is believed to act as a barrier to the northward migration of the oil in the sands on the down-thrown block of Pliocene sediments on the south side of the fault. This fault is part of a zone of disturbance which extends eastward past Whittier and is responsible for the structurally complex Puenta Hills north and west of Whittier. This last named town is mentioned in the dispatches as having been subjected to sharp shocks on July 16; further evidence of the probability of the cause of this earthquake being in the east-west line of disturbance just described. It would be natural to suppose that a readjustment of stresses along the Baldwin Hills-Dominguez Hills line in the earthquakes in June might develop stresses in the east-west line north of Los Angeles that relieved themselves by movements which caused the disturbances of July 16.

In connection with the earthquake history of the Los Angeles region, attention is called to the very recent earth movements that are recorded in the topography thereabouts. San Pedro Hill, over 1,000 feet in height, which marks the southwest corner of the Los Angeles Plain, has eleven wave cut terraces on its southern or ocean side, all of which are believed to be of Pleistocene age. Beds along the flanks of the Baldwin Hills-Dominguez Hills-El Cerrito fold, dipping over 30°, are known to be of Pleistocene age. Pleistocene fossils are found at a depth of over 1,000 feet in a well at Bells Station on the Los Angeles plain south of Los Angeles. At least

two different systems of terraces of Pleistocene age are found within the city of Los Angeles. Many other examples might be enumerated of evidences of the youth of the geologic and topographic features around Los Angeles, and along this part of the California coast in general.

Thus there are many reasons to expect frequent evidences of seismic activity in this region, but owing to the local character of most of the lines of structural weakness, extensive disturbances are not probable. The Great Earthquake Rift, or San Andreas Fault zone lies fully forty miles north of Los Angeles with several granite mountain ranges in between as buffers. Therefore the Los Angelenos may console themselves that they are not in the main earthquake belt.

Ralph Arnold

New York

AUGUSTO RIGHI

Often the death of a great personality in one of the fields of pure science is only felt directly by the small band of fellow workers in that field, while the passing away of one who has contributed but little original knowledge and has merely popularized the work of investigators makes a disproportionate impression on the general public, but in the death of Augusto Righi, professor of physics in the University of Bologna, and senator of the Kingdom of Italy, both the professional scientist and the amateur have suffered an irreparable loss. Righi combined in an inimitable way the ability to popularize the great central truths of his science with the genius of the born investigator. His published contributions in physical research cover the period of nearly fifty years and number nearly two hundred and fifty papers. Almost none of these papers are published in collaboration with other physicists, but represent his own individual work.

The present writer was privileged to spend part of one year as a guest in Righi's laboratory in Bologna. It was at the period when the first experiments of Sir J. J. Thomson and his pupils at Cambridge were providing the foundation for the beautiful structure of the electron theory which has since been reared. Righi had been carrying on investigations along lines which made him quick to seize the significance in his own problems of the work of the Cambridge School, and there was unmistakable evidence in his laboratory of great investigative activity—every evidence but for one fact: Righi never seemed to be working—he always seemed to have leisure to discuss other peoples' problems and to attend to the direction of the research of his numerous graduate students. Commenting on this one day to Righi the present writer learned that it was his custom to do all of his own investigative work in the three or four hours of the day before breakfast when he had his laboratory wholly to himself.

His treatment of his graduate students followed the German method rather than that which seems to characterize our own methods. He rarely published the results obtained in his laboratory jointly with the student but rather gave freely of his time and advice and let the student be the sole sponsor of his own work. A notable example of this is furnished in the well-known relation between Guglielmo Marconi and Augusto Righi—Righi, the friend and co-worker of Hertz and the teacher of Marconi, the pioneer in the adaptation of the epoch-making discovery of Hertz to telegraphy. Righi's friends appear to have been jealous lest he should fail to receive proper credit for his part in making wireless communication possible; but not so Righi himself, who cared little for popular applause and actually enjoyed a fuller measure of it in his own country than ordinarily falls to the lot of the pure scientist. His own attitude towards science is well expressed in his own words in an address before one of the many societies of which he was president.

> I refer to the pure science of physics, that science which does not occupy itself too much with matters of the practical application of its discoveries and does not trouble itself about the material advantages which may accrue to him who happens to make these discoveries, but above all else sets itself the task of establishing the great laws which govern the phenomena of the inanimate universe.

To this great task Righi devoted natural abilities singularly adapted to the needs of his science in the period of his greatest productive activity, when our views as to the nature of electricity and of matter were undergoing a fundamental reorganization.

Righi was a serious and well-trained thinker brought up in the old school and one who was too experienced to be led astray by brilliant generalizations which lacked sound experimental confirmatory evidence, and yet withal he possessed in some measure those gifts which we are most likely to associate with the poet or with women than we are with a man in an exact science—the gifts of imagination and intuition. That these two qualities were necessary in the building up of the electron theory nobody will deny. They are possessed by the living Thomson, Rutherford and a few of their co-workers and they were possessed by the dead Righi, and his name will stand with theirs in the history of his science.

Augustus Trowbridge

SCIENTIFIC EVENTS

THE CENTENARY OF SIR JOSEPH BANKS

The commemoration of the centenary of Sir Joseph Banks, Bart., who died on June 19, 1820, has been celebrated by the Linnean Society. According to the report in *Nature*, Dr. B. Daydon Jackson read the first communication on "Banks as a Traveller," speaking of his four overseas voyages—first, the visit to Newfoundland in H.M.S. *Niger*, on board which his friend Constantine Phipps, afterwards Lord Mulgrave, was a lieutenant; next, the adventurous voyage of the *Endeavour*, Lieutenant Cook commander, when Banks so amply proved his value in many untoward events; third, the voyage to Iceland; and fourth, his trip to Rotterdam in 1773, when he was still eager for an expedition to the north. The second paper, by Dr. A. B. Rendle, was entitled "Banks as a Patron of Science." Banks's life from his return to England in 1771 until its close in 1820 was that of an enthusiastic, liberal, and generally far-sighted patron of science. A friendship began with King George, which steadily increased, and Banks was consulted on important matters of very various kinds. He became botanical adviser to the King in relation to the Royal Gardens at Kew, which developed under Banks's guidance, becoming the repository of plants of economic and ornamental value from all parts of the world. Banks initiated or encouraged voyages of exploration, and kept up an extensive correspondence with men interested in science overseas. His house in Soho Square was the rendezvous of students and men of all classes interested in schemes of philanthropy or science; his magnificent library and herbarium were at the service of other workers, and after his death were bequeathed to the British Museum. For forty-two years he was president of the Royal Society. He was very closely, though indirectly, associated with the origin of the Linnean Society. Mr. James Britten, in the third paper, began by remarking that much of his paper was based upon the daily use of Banksian specimens for nearly half a century in the British Museum. The author showed that the popular belief that Banks left all his botanic work to his secretaries and curators, Solander and Dryander, was a mistaken one, and that Banks displayed great botanic acquirements. The president remarked that official records of the British Museum testified to the active interest taken by Banks in all matters connected with its advancement, and that keepers and trustees alike referred to him for his advice and decision. Certain objects closely connected with Banks were exhibited.

THE EPIDEMIC OF INFLUENZA IN ENGLAND

A further report on the great influenza epidemic has been issued by the Registrar-General. According to the abstract in the London *Times* the report states that the deaths allocated to influenza during 1918 numbered 112,329, the males being 53,883 and the females 58,446. The males included 7,591 non-civilians, and, deducting these, the deaths of civilians corresponded to a mortality of 3,129 per 1,000,000 civilian population.

No such mortality as this has ever before been recorded for any epidemic in this country since registration commenced, except in the case of the cholera epidemic in 1849, when the mortality from that cause rose to 3,033 per 1,000,000 population. None of the previous outbreaks of influenza can compare in mortality with that of 1918–19. During the 46 weeks, June 23–May 10, the total deaths allocated to the disease were 151,446, including 140,989 of civilians, the corresponding civilian death-rate for these 46 weeks being at the annual rate of 4,774 per 1,000,000 population.

It is pointed out that the mortality attributed to influenza does not represent the whole of that caused by it. The entries under other headings, especially those of respiratory disease, were always bound to increase during an epidemic, and though that did not occur in 1918 to the same extent as in other recent outbreaks, allowance must be made for these increases in mortality, allocated to other causes but really attributable to influenza, in endeavoring to measure the loss of life caused by the epidemic.

With regard to the deaths of females, when pneumonia, bronchitis, heart disease and phthisis are included, the deaths attributable to the epidemic during the third quarter of 1918 were 7,741, and during the fourth quarter 62,240. The figures for males for the same quarters were 8,088 and 51,359, respectively.

In earlier years influenza was less important under 55 years and more so above that period. In 1918–19 this position was suddenly and violently reversed. Those under 35 died in appalling number; those over 55 seemed to be relatively safe. The report says:

It may be doubted whether so sudden and so complete a change of incidence can be paralleled in the history of any other disease, yet all the weight of medical testimony goes to show that the influenza of 1918 was essentially the same as that of former years. Attempts have been made to explain the change as due to alteration in the circumstances of the population. Thus it has been suggested that aggregation of young women in munition works in 1918 may partly account for their specially heavy mortality. No simple explanation on these lines is possible. The alteration in age incidence accompanying the increased prevalence and fatality of the disease in 1918 seems to be more easily explained by a sudden change in the infecting organism than in the soil provided for its growth.

THE ENFORCEMENT OF THE FOOD AND DRUG ACT[1]

During the last few years the people of the United States have been given a very material amount of protection against those swindlers who sophisticate the foodstuffs and drug supplies of the country. Especially good work has been done in obtaining convictions against "patent medicine" fakers who have made false and fraudulent claims for their nostrums. This protection has been given through the enforcement of the federal Food and Drugs Act. The administration of this law rests with the Department of Agriculture, which acting through its Bureau of chemistry, collects evidence and lays the groundwork for the legal machinery of the government to proceed against the offender. The activity of the Bureau of Chemistry of the Department of Agriculture has, of course, aroused the strongest antagonism on the part of the nostrum interests. These interests may well rejoice in the recent action of congress in cutting down the appropriations for the Department of Agriculture. Even under the appropriation given for the last fiscal year, which ended June 30, 1920, the department was greatly hampered in its work of enforcing the Food and Drugs Act. Under the plea of economy, Congress has reduced the appropriation for the enforcement of this act by thirty thousand dollars. The *Oil, Paint and Drug Reporter,* a highgrade and conservative publication, well states the fact, in commenting on this disgraceful condition of affairs, when it says:

Under the reduced amount provided for next year, it will be impossible to supervise the regulation of the Food and Drugs Act as it should be supervised. This portends a rich harvest for those who misbrand and adulterate medicinal, pharmaceutical, disinfectant and other preparations. The vast public, which daily purchases and consumes

[1] From the *Journal* of the American Medical Association.

these products, will be the chief sufferer. At a time when the act requires enforcement of the most rigorous nature the Congress has succeeded in hamstringing it.

At a time, then, when in all lines of industry the spirit of exploitation is rife, Congress, under the specious plea of economy, practically nullifies the protective power of one of the most useful pieces of federal legislation ever enacted.

ALASKA SURVEYS AND INVESTIGATIONS IN 1920

Under the appropriation of $75,000 made for the investigation of the mineral resources of Alaska, the Geological Survey has dispatched seven field parties. The work to be done is that of extending the surveys and investigations which were begun in 1898.

G. H. Canfield is continuing investigations of the water powers of southeastern Alaska in cooperation with the Forest Service. The water powers are important not only to mining but to the wood-pulp industry.

In July L. G. Westgate will make a geologic reconnaissance of the region adjacent to Hyder, on Portland Canal, where gold and silver bearing lodes have been found.

F. H. Moffit, geologist, with H. Insley as assistant and C. P. McKinley, topographic engineer, are making reconnaissance surveys on the west side of Cook Inlet between Iliamna Bay and Snug Harbor. Their special mission is to survey the Iniskin oil field.

J. R. Eakin is making topographic reconnaissance surveys in the headwater regions of Susitna River, in order to complete as soon as possible the mapping of the region tributary to the government railroad.

P. S. Smith is making a geologic reconnaissance of the placer districts tributary to Richardson, on Tanana River. This region has long been a producer of placer gold in a small way. Promising deposits of auriferous gravels have been reported in it during the last two years.

Alfred H. Brooks accompanied Secretary Payne to Alaska in July, the objective being the Alaska Railroad and the Matanuska coal field. Later Mr. Brooks, in company with Arthur E. Wells, metallurgist of the Bureau of Mines, will visit some of the copper-bearing districts of the Pacific seaboard of Alaska.

G. C. Martin is on the way to McGrath, on Kuskokwim River, to investigate the mineral resources in that vicinity. This district produces considerable placer gold and contains some promising gold-bearing lodes.

The geologic and topographic reconnaissance surveys of Seward Peninsula were completed some years ago, but a detailed study of its mineral deposits must still be made, and this study has been assigned to S. H. Cathcart. Mr. Cathcart began work at Nome about July 1 and will continue until the end of the field season.

SCIENTIFIC NOTES AND NEWS

At its commencement exercises Harvard University conferred its doctorate of laws on Professor Roscoe Pound, dean of the Harvard Law School, whom President Lowell characterized as "lawyer and botanist; judge, teacher and writer, protean in interest; vindicator of the expansive power of the common law, who has also taken all jurisprudence as his privince and mastered it." In conferring degrees of doctor of science President Lowell said: "William Williams Keen: a surgical officer in the Civil War, the Spanish War and the World War—a man whose career in his profession has been one of long and ever rising distinction; the dean of American surgery." "Hermann Michael Biggs: Pathologist and physician; guardian of the public health; who, by his combat with tuberculosis in New York, has rescued countless lives."

Colonel Richard P. Strong, of Harvard University, chief medical director of the League of Red Cross Societies, has been elected to honorary membership in the Serbian Medical Society as an expression of admiration for his scientific achievements, and as a mark of appreciation for the great sympathy which he showed to the Serbian people.

Dr. J. S. Flett, F.R.S., at present assistant to the director in Scotland, has been appointed

to be director of the British Geological Survey and Museum. Dr. Flett succeeds Sir Aubrey Strahan, who retires when Mr. G. W. Lamplugh, F.R.S., assistant to the director in England, also retires.

Mr. E. A. Milne, B.A., Trinity College, has been appointed assistant director of the Solar Physics Observatory, Cambridge.

The David Syme prize, with medal, for the year 1920, has been awarded to Mr. Frederick Chapman, paleontologist to the National Museum and lecturer in paleontology in the University of Melbourne.

The president of the French republic has conferred the honor of officer of the Legion of Honor on Dr. Aldo Castellani, of the London School of Tropical Medicine, for his method of combined typhoid-paratyphoid and typhoid-cholera vaccination.

The ninetieth birthday of John Jacob Bausch, of Rochester, founder of the Bausch and Lomb Optical Company, was celebrated on July 25.

We learn from the *Journal* of the American Medical Association that Professor Luigi Pagliani, of the chair of hygiene in the University of Turin, reaches the age limit this year, and it is also the fiftieth anniversary of his professional career. He was the pioneer in organizing the public health service in Italy, in directing legislation and in controlling and preventing epidemics. A committee consisting of the incumbents of all the chairs of hygiene in the country has been formed to collect funds to found an annual prize, the Pagliani prize.

Julius C. Jensen, of the Weather Bureau, has been appointed vice-consul at Copenhagen, Denmark, and has sailed from the United States.

Professor H. C. Little, of Colby College, has been appointed executive secretary to the Division of Geology and Geography of the National Research Council.

A laboratory for research on dyestuffs and explosives has been established at George Washington University. The laboratory which is under the general supervision of Professor H. C. McNeil, will be in charge of Mr. G. W. Phillips, formerly of the Chemical Warfare Service. Dr. C. E. Munroe, of the National Research Council, will be consulting chemist of the laboratory.

Dr. A. C. Trowbridge, professor of geology at the University of Iowa, has been offered a position with a New York Company to carry geological work in South America next year, but has declined and will remain at the state university. At present Professor Trowbridge is in Texas working for the United States geological survey.

Dr. Harvey Bassler, formerly paleontologist with the U. S. Geological Survey, is now engaged in exploratory work for the Standard Oil Company in South America.

Mr. R. M. Overbeck has returned from Bolivia and has resumed work in Alaska for the U. S. Geological Survey.

Dr. Jacob Sobel has been designated assistant director of the Bureau of Child Hygiene of the New York City Department of Health.

Dr. Helen MacMurchy, Toronto, has been appointed to take active charge of the division of child welfare in the federal department of health, Ottawa.

Dr. Harlan I. Smith, of the Canadian Geological Survey, has left Ottawa to carry on an archeological reconnaissance in the Bella Coola Valley of British Columbia.

Mr. Charles M. Hoy is collecting for the Smithsonian Institution in Australia.

Professor Warren D. Smith is taking a leave of absence for one year from the University of Oregon to go to the Philippines as chief of the Division of Mines of the Bureau of Science in order to rehabilitate the work of that department. En route to the Philippines he will attend the Pan-Pacific Scientific Congress in Honolulu, August 2–20, as delegate from the University of Oregon. He expects to return to the University of Oregon in October, 1921.

Roald Amundsen, the Norwegian explorer, arrived in Nome on July 23, having made the voyage from Norway through the waters north

of Europe and Asia. In 1906 Amundsen followed the northwest passage from the Atlantic to the Pacific around North America.

The committee which plans to erect an Osler Institute of General Pathology and Preventive Medicine in Oxford to commemorate the distinguished services of Sir William Osler in Canada, in the United States and in England, is about to issue an appeal for funds. The general committee contains representatives of the universities of Aberdeen, Birmingham, Bristol, Cambridge, Durham, Edinburgh, Glasgow, Leeds, Liverpool, London, Oxford, Sheffield and Wales, and also of the Royal Colleges of Surgeons and Physicians, of the Faraday Society, of the British Association, and of the British Academy.

The death is announced of Professor Alexander Supan, chief of the Geographical Institute of Breslau, in his seventy-third year.

The death is announced of William Schallmayer, one of the best-known German students of eugenics.

Arthur J. Ellis, geologist on the U. S. Geological Survey, died July 22, following an operation for appendicitis. A correspondent writes: "Born in Kansas January 6, 1885, he spent his boyhood in Illinois and in 1908 married Orrel Everett, who, with their daughter, survives him. He received the degrees of B.A. in 1908 and M.A. in 1911 from the University of Illinois. After an experience of several seasons on the Illinois Geological Survey, he was appointed to the U. S. Geological Survey in 1911 and was assigned to work on the Ground Water Division, in which he rose to the position of assistant chief. He is the author of reports on the ground waters of Connecticut, the geology and ground waters of San Diego county, California, and several unpublished manuscripts, a number of which are reports on water supplies for military purposes made during the war. His most widely read publication is a 'History of the Divining Rod.' The survey has lost a valuable member and the profession a young man whose painstaking work pointed to a useful future. His friends appreciate that they have known a rare spirit, which rose above the difficulties and sacrifices of a life devoted to science."

At a recent Cambridge meeting of the British Medical Association it was decided to increase the annual subscription from two to three guineas. The reason for the increase was not only the great increase in the cost of producing the *Journal* in all directions, but also the need for adequate funds to carry on the forward policy of the association.

The hospital installed by Brazilians in Vaugirard, France, at a cost of $2,000,000 has been offered by the government of Brazil to France and has been accepted by the Paris Faculty of Medicine.

It is announced that the Swedish parliament has appropriated 50,000 crowns for the yearly maintenance of the Institute for the Study of Heredity at Upsala, of which Professor H. Lindborg is in charge.

A research association for the cutlery industry has been approved by the British Department of Scientific and Industrial Research. The secretary of the committee engaged in the establishment of the association is Mr. W. H. Bolton, Sheffield.

The Bureau of Mines has completed arrangements for a cooperative research on the carbonization of lignite. $200,000 is to be supplied by private parties for the erection of a plant at New Salem, North Dakota. The bureau will be in charge of the technical and experimental side of the investigation.

We learn from *Nature* that the Marshall herbarium, comprising 23,000 sheets of British plants contained in dustproof oak cases, has been bequeathed to the university by the late Rev. E. S. Marshall.

By the will of the late Dr. Rudolph Messel, the Royal Institution of London receives £5,000.

The new library building of the Nantucket Maria Mitchell Association, opposite the Memorial House and Observatory, Nantucket, Mass., was dedicated on July 15. This is a scientific library free to all interested in astronomy or any of the natural sciences. It is

planned that the increased space for books will meet all demands of nature lovers. The library is open: 10 to 12 A.M. and 2 to 5 P.M., from June 15 to September 15 each year, and during the winter two afternoons of each week from 2 to 4

Geo. P. Gray has resigned his position as assistant professor of entomology and chemist, insecticide laboratory at the University of California to become chief of the division of chemistry of the State of California Department of Agriculture, with headquarters at Sacramento. The Department of Agriculture established at the last session of the California legislature was fostered by Governor Stephens as an economy and efficiency measure, and correlates under Director G. H. Hecke, several boards and commissions formerly charged with the enforcement of various laws pertaining to agriculture. The work of the department is organized into three divisions: Plant Industry, Animal Industry and Chemistry. The Division of Chemistry, under Professor Gray, is to handle the official analysis and testing of materials incidental to the administration of the state laws regulating the manufacture and sale of insecticides, fungicides, fertilizers and dairy products and the fruit and vegetable standardization laws.

It is stated in *Nature* that the British Medical Research Council has recently established at the Lister Institute of Preventive Medicine a national collection of type cultures from which biologists in general, and bacteriologists in particular, may obtain authenic strains of recognized bacteria and protozoa for use in scientific work. The scheme is under the general direction of Dr. J. C. G. Ledingham, while Dr. R. St. John Brooks has been appointed to the post of curator of the collection and Miss Mabel Rhodes to that of assistant curator. It is proposed to collect and maintain bacterial strains from all departments of bacteriology, human, veterinary and economic, and already considerable work has been done towards the formation of a representative collection on these lines. The efforts of the staff are, however, at present particularly directed towards the securing of fully authenticated strains responsible for or associated with disease in man and animals. The bureau proposes to supply cultures on demand to all workers at home and abroad, and, as a rule, a nominal charge per culture will be made to defray postage and media. Strains sent for identification and maintenance should be accompanied by particulars as to source, date of isolation, etc. In due course a catalogue will be prepared for publication.

UNIVERSITY AND EDUCATIONAL NEWS

A plan for securing within five years $10,000,000 to meet the urgent needs of the University of Chicago is now being carried out. For salary increases already made or authorized the sum of $4,000,000 as additional endowment is needed. The new plans involve also the formation of certain institutes within the graduate school for conducting such research and training in pure science as has an immediate bearing on the application of the sciences to industry. The institutes proposed are those of physics and chemistry, plant agriculture, mining and the science of education.

Professor O. M. Leland, formerly of Cornell University, but recently of the J. G. White Engineering Corporation, New York City, has been elected dean of the colleges of engineering, architecture and chemistry in the University of Minnesota. During the war, Professor Leland was lieutenant colonel of engineers in the 78 and 89 Divisions and saw active service in France and Germany. Up to a few months ago, he had been a member of the Cornell faculty since 1903.

Dr. O. E. Jennings, curator of botany at the Carnegie Museum and for several years in charge of the work in botany at the University of Pittsburgh, has been given the rank of professor of botany at the latter institution.

Dr. Claude S. McGinnis has joined the faculty of Temple University, Philadelphia, as professor in the department of physics. Dr.

McGinnis has been for nine years professor of physics and electrical engineering in the University of New Brunswick, Fredericton, N. B.

DR. HARRY B. YOCOM, of the department of biology of the College of the City of New York, has been appointed assistant professor of zoology in the University of Oregon.

DR. F. FRANCIS, professor of chemistry, has been appointed pro-vice-chancellor of Bristol University, in succession to Professor C. Lloyd Morgan, who is about to resign office. Dr. Lloyd Morgan has been appointed emeritus professor of psychology and ethics.

DISCUSSION AND CORRESPONDENCE

A PRIORI USE OF THE GAUSSIAN LAW

TO THE EDITOR OF SCIENCE: Mr. Michael[1] in interpreting Dr. Johnstone's results[2] for twenty counts of bacteria in polluted shellfish deplores certain naive errors to which the lay statistician is prone, but is not, so it seems to me, free from statistical illusion himself. I had hoped, at least, that the identification of the Gaussian law with the ideal "chance" distribution was a custom of the past, and that the prevalence of this practise in the literature was simply due to the inertia of thinking. May I submit the following relevant observations?

1. The sole condition of "change" is ignorance.[3] In science the thing to do with ignorance is to admit it, not to posit the form of distribution that a variable assumes under it.

2. Biological and mental phenomena, of whose conditions of variability we are thus ignorant, do not necessarily give symmetrical distributions when observed. Pearl showed that the amount and direction of skewness and the dependence of skewness on known conditions might be the significant biological fact.[4] The Gaussian law does hold for coin-tossing, but the relationship has been scientifically observed,[5] not posited a priori.

3. Moreover, there can be no reason to expect a Gaussian distribution a priori when we are ignorant. A form of distribution is always function of the unit of measurement; and, since the choice of a biological unit is ordinarily arbitrary, the chances of getting the normal distribution are very small.[6] Galton pointed out, furthermore, that chance distributions of two related variables, when the relationship is not linear, can not both be Gaussian.[7]

4. When we observe a skew distribution and are in ignorance of the conditions that cause the variation, it is useless labor to factor the skew distribution into a Gaussian "chance" distribution and a skewing factor, as Mr. Michael does. The two factors that we so obtain are meaningless. The Gaussian function is biologically meaningless because there is neither a priori nor observational ground for taking it as the curve of chance (ignorance). Mr. Michael's logarithmic function is biologically meaningless because it is merely a measure of the manner in which the observed data depart from the meaningless Gaussian law. Pearson saw this point in 1900 and noted the fallacy.[8] He also made fun of the Gaussian "fetish," although the position of the Biometric School has since become less definite.

5. Probability in science means frequency and nothing more. Fundamentally in science

[1] E. L. Michael, "Concerning Application of the Probable Error in Cases of Extremely Asymmetrical Frequency Curves," SCIENCE, N. S., 51, 89–91.

[2] J. Johnstone, "The Probable Error of a Bacteriological Analysis," cited as Rept. Lanc. Sea-Fish. Lab., No. 27, 1919, 64–85.

[3] *Cf.* J. Venn, "Logic of Chance," 1888, espec. 119 ff.; B. Bosanquet, "Logic," 1911, I., 322 ff. If the scientist prefers not to go to the logician, let him see if he can formulate for himself, with scientific rigor, the conditions of "chance."

[4] R. Pearl, "Variation and Differentiation in *Ceratophyllum*," 1907, espec. 90 f.

[5] *E. g.*, see H. Westergaard, "Grundzüge der Theorie der Statistik," 1890, 21–38.

[6] J. Bertrand, "Calcul des probabilités," 1889, 180 f.

[7] F. Galton, *Proc. Roy. Soc.*, 29, 1879, 365–367.

[8] K. Pearson, *Philos. Mag.*, 5th ser., 50, 1900, 173.

it means observed frequency. The value of the statistical constants is simply that they provide a conventional method of summarizing frequencies of observed data. To shift the meaning of probability from observed frequency to predicted frequency is precarious, although we are always attempting it in scientific generalization. However, it takes more than a process of division by the square root of the number of cases—the obtaining of the probable error of the mean—to bridge the gulf between observation and prediction. The lay conviction that the probable error of the mean is actually a prophecy is hard to overcome. That it is not prophetic will become clear to any one who will take the trouble to fractionate a large body of data, compute the probable errors of the means of each fraction and note how they vary, and then compare all these discordant predictions with the actual probable error of the means computed from the array of means. The probable error of the mean is a useful constant since it summarizes the variability of data in relation to their amount; but it is not a key to the future.

All this is negative. Actually what was Dr. Johnstone to do? First, observe and report, I should say; and let him predict who will. Certainly there is no need for much statistics to summarize his twenty cases. He wishes to know the most probable number of bacteria per cc. in this emulsion. Scientifically by the most probable number is meant the most frequent number; and his data show that 6–10 counts were more frequent than any other. Why obscure the simple fact by a statistical superstructure? If now he wishes to risk prediction on the basis of 20 cases, he may say that 6–10 counts will occur more often in his 250 c.c. than any other group, 16–20 counts next most often, 11–15 and 21–25 counts less often, and so on. This course has the simple merit of telling the observed truth and doing very little more.

In predicting the total number of bacteria within the 250 c.c. one must multiply the arithmetic mean of the counts by 250. We have given the distribution of 20 counts and we have no alternative to assuming that it is the most probable distribution of 20 counts. Hence we must take the observed distribution as many times over ($12\frac{1}{2}$ times) as 20 will go into 250 and sum all the frequencies. Dr. Johnstone found 366 bacteria in 20 c.c. The most probable number in 250 c.c. must be $250/20 \times 366 = 4{,}575$. Mr. Michael gets 4,005 by the erroneous assumption that the most probable (most frequent) logarithm is the logarithm of the most probable (most frequent) count, which is plainly impossible since the logarithmic relation is not linear. The illusion arises because we take it for granted that any most probable natural number must be inseparably connected with the most probable logarithm. When we substitute the word "frequent" for "probable" we may see our mistake, for the logarithms of the small numbers are more frequent than the logarithms of the large numbers.[9]

Concerning the general problem of obtaining "the probable error of extremely asymmetrical frequency curves," I would urge that in simple cases it is unnecessary to depart far from the observed facts. Usually one is most interested in the value of the most frequent (most probable) case and in the amount of deviation on either side. The values of the mode and of the upper and lower quartiles give this information, as well as the range within which half the cases have fallen and an indication of the skewness. Except the gift of prophecy, what more could one want?[10]

Edwin G. Boring

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ALBINO VERTEBRATES

In July 1919, on the Beaver River near the mouth of the Dore River in Saskatchewan, I shot a pure albino grackle (*Quiscalus quiscula æneus*). It was a young male, 10.5 inches long, and was associated with a flock of grackles. It seemed much less shy than the

[9] S. Newcomb, *Amer. J. Math.*, 4, 1881, 39 f.

[10] See in general, "The Logic of the Normal Law of Error in Mental Measurement," *Amer. J. Psychol.*, 31, 1920, 1.

rest of the flock. I have sent the damaged skin to the Provincial Museum at Regina.

In the summer of 1915, two living albino specimens of Richardson's spermophile (*Citellus richardsoni*) were sent to this university from near Hanley, Sask. I saw them, but through carelessness they were both lost before further data were obtained.

An albinistic crow of a very light brown shade is among the stuffed birds of the university collection. Beyond the fact that it was taken in Saskatchewan, I have been unable to learn anything about it.

John S. Dexter
University of Saskatchewan

A PLEA FOR MORE EXPLICIT DESIGNATION OF SCIENTIFIC REPRINTS

The library of the Bureau of Fisheries contains one of the largest, if not the largest, collection of reprints on the subject of aquatic biology. It is the practise of the bureau to make analytical cards of all such separates, copy being furnished the Library of Congress by which the cards are printed. These cards become part of the Library of Congress issue and have world-wide distribution.

That the cards may be used with confidence by those needing them for bibliographical purposes and unable to consult the volumes in which they have appeared, it is necessary that the cards not only show the source of the reprints but also give the place of publication, date, volume, and pagination. Unfortunately separates are frequently devoid of such data. It is astonishing indeed that a great number of reprints are found to be without indication of the year of publication; many give no reference to the journal from which they are reprinted; and nearly all lack mention of the place of publication. Frequently the publication in which the article originally appeared is not available; but even when it is at hand the librarian has no right arbitrarily to give the place of publication of the original as that of the reprint, unless the reprint so states. Difficulty is frequently encountered with reprints which carry only a caption title and bear no date of issue; in such cases, it may be possible to give the date which appears on the title page of the volume (provided the volume is available) but frequently the issue of the volume is antedated by the separate. The date of first publication is of paramount importance in certain instances, as every investigator knows.

The Bureau of Fisheries has endeavored to establish a standard of high efficiency in the bibliographies attached to its publications, and publishes none submitted until they have been fully verified. If all reprints consulted by authors compiled with the simple and obvious requirements of bibliographical reference, much labor would be saved and greater accuracy assured. Under present conditions much time is frequently required, to locate original papers and, failing in this, it is sometimes necessary to return bibliographies to the investigators, only to find that, in some cases, they have seen only the separates and can not therefore authoritatively supply the necessary data.

It is of course of vital interest to investigators that their papers be cited correctly and it is therefore important that every author see to it that his reprints indicate not only the source, but also place, date, volume and pagination. This end could readily be accomplished with the cooperation of editors and publishers of scientific journals, proceedings and transactions of scientific societies, and state and institutional reports and bulletins. The slight additional labor involved would be fully justified by the saving of time and worry of other investigators, librarians and editors, and by the prevention of confusing errors of citation.

Rose M. MacDonald
Librarian, U. S. Bureau of Fisheries,
Washington, D. C.

SCIENTIFIC BOOKS

Report of the Second Norwegian Arctic Expedition in the "Fram," 1898–1902, 4 volumes in 36 parts, large octavo, 1907–1919, 9 maps, 111 plates, and 2,071 pages of text. Published by the Society of Arts and Sciences of Kristiania (Videnskabs-Selskabet i Kristiania), at the expense of the Fridtjof

Nansen Fund for the Advancement of Science.

During the first Norwegian Arctic expedition, when the attaining of the North Pole by Nansen was the main object, Captain Otto Sverdrup expressed the desire to return to Arctic lands for exploration and mapping of portions of the American Arctic island archipelago. The fulfilment of this desire was made possible through gifts of about $60,000 by Consul Axel Heiberg and the Ringnes brothers, brewers in the city of Kristiania, the same three men whose generosity made possible the first Arctic expedition in the *Fram*. This staunch vessel, repaired and ready for a second time to pass through the ordeal of ice-bound seas, was the Storthing's contribution to the expedition. A more productive exploration of Arctic lands, with so small a sum of money, has not been made before, and the names of the donors are now permanently fixed in geography in the new islands, Axel Heiberg Land, Amund Ringnes Land and Ellef Ringnes Land. The expedition explored and mapped about 100,000 square miles, the greater part of which is new territory. Like most Arctic explorations, its successes were won through the hardest kind of work, and two lives were sacrificed to the advance of knowledge, those of the physician, Johan Svendsen, and the sailor, Ove Braskerud.

Captain Sverdrup was assisted in his work by fifteen men. Of these G. I. Isachsen was the cartographer, H. G. Simmons the botanist, Edvard Bay the zoologist, and Per Schei the geologist. A better fitted and a more loyal band of hard workers—both men of science and sailors—never explored unknown lands. They brought back the results and collections which are in the main described, either in English or German, in these four handsome volumes. It is a source of regret that Per Schei did not live to see the final working up of his grand geologic collections, since all attest that this warm-hearted man of science collected a vast mass of material; in fact, it may be said of him that he made accessible to paleontology and stratigraphy more information of an exact nature than all previous Arctic expeditions.

These four volumes, together with Captain Sverdrup's popular account, entitled "New Land" (2 volumes, 1904), should be in every scientific library, not only because of their great intrinsic value, but because we owe it to our Norwegian friends thus to show our appreciation of their splendid achievement.

The astronomical and geodetical observations are described by Isachsen (141 pages) and pictured on three large, topographically shaded maps, one of the most important results of the expedition. Terrestrial magnetism is treated by A. S. Steen (82 pages); the results here are important because the Sverdrup expedition worked for four years not far from the magnetic north pole. However, due to the lack of proper instruments and to other causes, the hoped-for results were not fully attained. The section on meteorology is by H. Mohn (399 pages) and consists of the facts gathered by the expedition, here detailed in tables presenting the atmospheric pressure, temperature of the air, humidity, winds, clouds, and precipitation.

All naturalists traveling in the far north are surprised by the extraordinary abundance of plants that come to life and bloom during the very short but extremely active growing season. Flowers may be gathered early in June, and for a month during June and July the plants grow day and night, because of the nightless days, and beautiful flowers of Alpine kinds may be collected within a few feet of the ice fields. There are no trees, and but few plants attain a foot in height, and yet in spots there is a green covering. Most of the plants grow in tufts and peripherally in small and large mounds. The entire growing season is less than four months long and yet during this time is made the necessary food on which the land animals subsist. Of these latter there are at least 30 kinds of insects, 7 spiders, 5 birds, and 9 mammals (polar bear, wolf, fox, ermine, glutton, lemming, hare, muskox, and reindeer). The two last named are large animals, and one wonders where they get sufficient food during the long winter.

The plant material gathered by Simmons amounts to over 50,000 specimens and is described in eight papers, though the marine algæ are not treated here. These results are a monument to the botanist's industry. Of fungi, E. Rostrup determines 80 forms. The lichens, in more than 7,000 specimens, are described by O. V. Darbishire, who states that they form the best collection ever made from the American Arctic. He describes 161 forms, and adds that about 253 lichens are now known from the region explored by the *Fram*. Among them is the food for reindeer and muskox. Of mosses, N. Bryhn describes 290 forms, of which 49 are new. The vascular plants (about 190 species) are determined by Simmons in three papers. Ellesmere Land alone has at least 115 flowering plants, and while in general this flora is a continuation of that of Greenland, yet there is a strong American trait (about 25 per cent.) that has come from the west. Curiously, the flora is most abundant on granite lands, richest on bird grounds and around Eskimo habitations, and least developed on Paleozoic limestone. An abundance of ground-water here as elsewhere is a first necessity.

The Eskimo and Arctic travelers are always interested in the stranded drift logs in these treeless lands, since at times and places driftwood is common. Where does it come from? In some places good logs have been seen at elevations of about 300 feet above the sea. The Eskimo make their sledges, boats, and spears of them, since these cooled climates wood does not decompose and will remain intact indefinitely. The naturalist, however, is interested in their source. The *Fram* expedition collected 40 samples and these have been determined by F. Ingvarson, who tells us that there are three main sources for this wood, first, from the great Yenisei and Lena rivers of Siberia, second, from the St. Lawrence river, and finally, from the coast of Norway. Their distribution is brought about by the polar current drifting the Siberian woods, some across the north pole and others westward toward the east coast of Greenland, thence south and again north along the west coast of that country. The wood of the St. Lawrence is caught up by the Gulf Stream and drifted against Norway, where it gets mixed with Norwegian logs and both are borne westward against Greenland and so eventually attain Davis strait as far north as 62° 25′. In this way 31 species of forest trees may have attained the American Arctic archipelago (5 species of Siberian conifers and 6 of dicotyledons; 2 of Norwegian conifers and 9 of dicotyledons; and of American woods, 4 conifers and 5 dicotyledons). As conifers are most common in northern forests and float the longest, the dicotyledons soon becoming water-logged, they are the woods commonly met with in high Arctic regions.

In the summer time, Arctic waters are alive with migrant water birds, at least 18 species of which are here recorded. In this region they rear their young, and this means that the waters must be alive with animal food, a fact further attested by the former abundance of great migrant whales, and the presence of 5 species of native seals and of the walrus. The seals feed on fish and the walrus on molluscs, but the remainder subsist in the main on Crustacea. Of the latter, G. O. Sars describes no less than 154 kinds, among which the copepods (71 forms), amphipods (38), isopods (11), and ostracods (11) make up the bulk of the swimming invertebrate life. Back of all this animal life, however, there must be an abundance of plant life. Seaweeds are common enough below low-water mark, but the bulk of animal subsistence must be sought here, as elsewhere, in the phytoplankton, described in these reports by H. H. Gran. This author, however, states that the collections were wholly inadequate, and from the high seas, and that the actual Arctic phytoplankton was collected at but one place during middle August. J. A. Grieg describes 53 species of Mollusca and one of brachiopods, all from less than 150 feet of water. Of bottom-living Foraminifera, H. Kiær lists about 50 forms; and O. Nordgaard identifies 77 species of bryozoans, all of which are very different from those of Antarctic

waters. The Echinodermata, described by Grieg, include 2 crinids, 6 starfish, 6 ophiurids, strangely only 1 sea urchin, and 4 holothurians. The rest of the described marine fauna consists of 2 sponges, 4 actinians, 6 sea-squirts, 10 hydrids, 4 medusæ, and 44 kinds of polychæte worms. Clearly Arctic waters do not teem with a variety of animal life, but they make up for this in abundance of individuals.

The geologic results of Per Schei are very rich, not only in the abundance and variety of fossils gathered, but also in the record of the distribution of the various formations. Over the Archeozoic granites of Ellesmere Land lie about 14,000 feet of Paleozoic strata, beginning with Upper Cambrian, followed by basal Ordovician (Beekmantown), middle Ordovician, early and middle Silurian, and an extraordinary development of Devonian, having a thickness of about 6,000 feet (marine Lower and early Middle Devonian and an Upper Devonian fresh-water facies). The Carboniferous is known only in highest Pennsylvanian rocks, followed by marine Upper Triassic. Then there is no sedimentary record of any kind until the deposition of the Miocene fresh-water beds with lignites. As Per Schei died soon after the return of the expedition, the fossils are described by O. Holtedahl in three papers, one of which gives a summary of the geological results attained. The land plants of the Upper Devonian and the very few from the Miocene are described by A. G. Nathorst; the Devonian fishes by J. Kiær; the Devonian invertebrates by O. E. Meyer and S. Loewe; the Upper Carboniferous fauna by T. Tschernyschew and P. Stepanow; and the Triassic marine invertebrates by E. Kittl.

From Per Schei's account and the splendid photographs (the best Arctic pictures anywhere), it is evident that Ellesmere Land is an elevated and dissected table land, rising directly toward Greenland. Elevated strandlines and wave-cut terraces are seen along most shores, and are of various altitudes up to 570 feet. On one at 300 feet lie undecomposed driftwood and logs, attesting the recentness of some of this elevation.

Norsemen are still lovers of heroic work, and the north lands are their special scientific field. From them we are learning the geography, geology, and biology of the lands of the midnight sun on either side of Greenland, the territory of the Danes. We need, however, still more information about these almost inaccessible places, and let us hope that the Norwegians will soon extend their endeavors and modernize our knowledge of Nova Zembla.

Charles Schuchert

SPECIAL ARTICLES

COMPUTING AGES OF ANIMALS

In the various experiments on animals in regard to growth, nutrition, activity, reproduction, etc., it is necessary to determine the age of the individuals at various times in their lives. These computations, involving mere additions and subtractions, take a great deal of the experimenter's time. The task is monotonous and soon becomes a matter of great drudgery.

Having before me the task of making several thousand such computations I sought a means of obtaining this data in a quicker and less tedious manner. The instrument described and used by Minot in his work on the guinea pig appealed to me. It had, however, the objectionable feature that the age of but one animal could be ascertained at a time. As I was dealing with a pair of animals whose weights were made on the same day and whose ages were to be determined when litters were born it was necessary to devise a scheme whereby the ages of two individuals born on different days could be readily determined at various times in their lives.

The device finally hit upon is so simple to make and operate that I have deemed it worthy of a description in order that others who may be wrestling with such tedious computations may be relieved of their drudgery.

The device consists of three meter sticks, *M*, *A*, and *F*, with two guides, *G*, *G*. The middle meter stick and the two guides are fastened securely to a board and the other two meter sticks slide freely. To facilitate

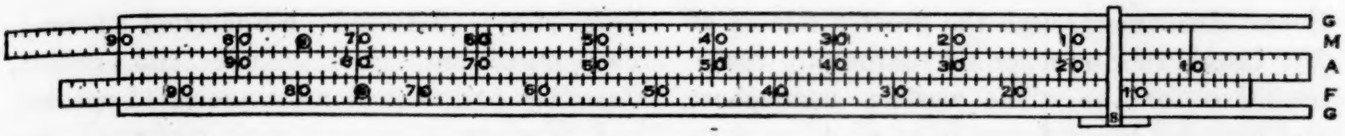

FIG. 1.

movement a small knob, K, is screwed to each of the movable sticks. A slider, S is made like a small T-square. It crosses the sticks at a right angle and can be moved freely along them. The two guides are slightly thicker than the meter sticks so that the movement of the slider does not change the position of the movable meter sticks. M is used in determining the age of the male and F that of the female. For the sake of simplicity the millimeters are not shown in the figure.

The method of using this device is best illustrated by an example. Suppose the male of a pair was born on April 10, 1919, and the female on February 19, 1919. The first date is the 100th day of the year, and the second date is the 50th day. A calendar having all the months of the year on one page and also having each day in the year numbered consecutively from both the beginning and the end of the year is used for determining what day in the year a certain date represents. Stick M is moved until its right end is even with the 100-millimeter mark on A and F is similarly moved to the 50-millimeter mark. If a weighing were made on June 9, 1919, which is the 160th day of the year, the slider is moved to the 160-millimeter mark on A. The age in days of each animal is now indicated on their respective sticks by the number of millimeters to the right of the slider. That is, the male is 60 days old and the female 110. If the age is to be computed on November 27, 1919, the 331st day of the year, the slider is moved to 331 on A and the age of each at once read off, which is 231 and 281 days respectively. The ages at any date in 1919 can thus be computed without moving anything but the slider.

If a date occurs in the succeeding year, 1920, then the sticks would require resetting. This is done in the following manner. The slider is moved to the 365 mark on A, which represents the last day of 1919, and the readings taken on M and F. These are 265 and 315 respectively, that is, the ages on December 31. These two numbers may also be found on the calendar since they are the days in the year when numbered consecutively from December 31 to January 1 corresponding to the two dates of birth. M is now moved to the right until its 265 millimeter mark is even with the end of A and F is moved in a similar manner until its 315 mark is even. This arranges the instrument for any date in 1920. If the ages are desired on March 28, 1920, the 87th day of the year, the slider is moved to 87 on A and the ages of the two animals are at once indicated as 352 and 402 days respectively. In this manner the ages may be rapidly determined for any date desired. It is obvious also that the device can be arranged to give the ages when the two animals are born in different years.

The limit of capacity of this device is 1,000 days. But in dealing with animals with a longer span of life each millimeter can represent a week, a month, or a year and the ages computed in these periods of time.

The excuse for this article is the hope that it may help some one who is confronted with a series of tedious computations similar to the ones with which I have had to contend.

J. ROLLIN SLONAKER

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THE CLASSIFICATION OF THE OPALINIDÆ

I HAVE completed a study of one hundred and thirty-four species and twenty subspecies which according to the prevalent usage would be included in the genus *Opalina*. Twenty-four species were known before. My material, obtained mostly from the United States Na-

tional Museum through the great kindness of Dr. Leonhard Stejneger, is thoroughly representative for the whole western hemisphere and includes many forms from all other parts of the world, Africa, Europe, temperate Asia, the East Indies and Australia being well represented. Southern Asia is the only region from which there is but little material. Clear presentation of the taxonomic conditions shown in the rather large amount of data necessitates a more elaborate classification of the Opalinidæ than that generally in use. In the year 1918 I published a classification of the Opalinidæ. The completed review of all the material shows that this classification, if elaborated somewhat will be a clearer expression of the real facts. I therefore now propose the following classification:

- Ciliata
  - Protociliata
    - Opalinidæ
      - Protoopalininæ
        - *Protoopalina*
        - *Zelleriella*, new genus
      - Opalininæ
        - *Cepedea*, new genus
        - *Opalina*
          - *Opalinæ angustæ* (*occidentales*)
          - *Opalinæ latæ* (*orientales*)
  - Euciliata

The Opalinidæ are placed as an appendage of the Ciliata, being separated from the other Ciliata by the fact that they have not developed macronuclei and micronuclei, and by some features of their life history. They show, both in their structure and possibly in their life history, decided indication of relationship to the Trichonymphidæ which are usually regarded as an appendage of the Flagellata.

From the Opalinidæ I exclude all the genera of Ciliata astomata, which have nuclei of two sorts, leaving, only those forms which, with the exception of my own recent usage, have been included in the genus *Opalina*. The Opalinidæ include both binucleated and multinucleated species and these should be assigned to distinct subfamilies.

The Protoopalininæ include the genera *Protoopalina* (cylindrical binucleated forms) and *Zelleriella*[1] (flattened binucleated forms). The Opalininæ also include two genera, *Cepedea*[2] (cylindrical multinucleated species) and *Opalina* (flattened multinucleated species). The latter genus includes two groups of species—the western hemisphere forms, which are for the most part narrow, especially posteriorly, and the eastern hemisphere species, all of which are broad. All the other Ciliata may be classed as Euciliata in distinction from the Protociliata which include only the Opalinidæ.

There are two species which do not accurately fit into this classification as defined. They are *Protoopalina quadrinucleata* from *Rana macrodon* of Java and *Protoopalina axonucleata* from *Bufo bufo asiaticus* of eastern Asia. These species will be described in a paper soon to go to press. They are mentioned here merely because the former usually has four nuclei and the latter usually shows six to twelve nuclei. They are transitional forms between the genera *Protoopalina* and *Cepedea*, but are classed with the former genus because of the histological character of their nuclei which resembles that of the *Protoopalina* nucleus.

Maynard M. Metcalf
The Orchard Laboratory,
Oberlin, Ohio,
May 20, 1920

THE OHIO ACADEMY OF SCIENCE

The thirtieth annual meeting of the Ohio Academy of Science was held at the Ohio State University, Columbus, May 14 and 15, 1920, under the presidency of Professor F. C. Blake. Sixty-nine members were registered as present; thirty new members were elected.

The executive committee reported the completion of the affiliation of the academy with the American Association for the Advancement of Science in accordance with the plan adopted by the association at the Christmas meeting.

[1] Named for Ernest Zeller who in the year 1877 published a fine paper upon the European species of the family.

[2] Named for Cassimer Cepede whose studies upon Ciliata astomata clearly showed that the Opalinidæ are to be regarded as quite distinct from the other astomatous forms.

It was reported by the trustees of the Research Fund that Mr. Emerson McMillin, of New York City, had made a further contribution of two hundred and fifty dollars to the research fund. In view of his continued financial support of the research work of the academy Mr. McMillin was elected a patron; he was also elected to fellowship in the academy on the strength of his own contributions to science.

The following special resolutions were adopted by the academy:

1. Recording appreciation of the work of the Ohio Biological Survey and expressing the hope that its work, now financially crippled, may be continued with increased support.

2. Urging the utmost watchfulness in the conservation of platinum and condemning its use "in jewelry and in any other way that is not productive of scientific or industrial advance or development."

3. Urging a like conservation of potassium and the use, wherever practicable, of sodium salts as a substitute for potassium salts in scientific and commercial work.

4. Endorsing the work of the State Department of Agriculture in establishing preserves for game and other wild life of the state, and appointing a committee to cooperate in this work. This committee, under the chairmanship of Professor Herbert Osborn, of Ohio State University, is in position to cooperate also in the nation-wide movement in this direction instituted by the Ecological Society of America and endorsed by the American Association for the Advancement of Science.

Officers were elected as follows: *President,* W. H. Alexander, Weather Bureau, Columbus; *Vice-presidents:* Zoology, F. H. Krecker, Ohio State University; Botany, C. H. Otis, Western Reserve University; Geology, W. H. Bucher, University of Cincinnati; Physics, D. C. Miller, Case School of Applied Science; Medical Sciences, Ernest Scott, Ohio State University; Psychology, H. A. Aikins, Western Reserve University; *Secretary,* E. L. Rice, Ohio Wesleyan University; *Treasurer,* A. E. Waller, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

The Einstein theory of relativity and gravitation: Professor F. C. Blake, Ohio State University.

PUBLIC LECTURE

Photographing sound waves from large guns and projectiles: Professor Dayton C. Miller, Case School of Applied Science.

SYMPOSIUM BEFORE PHYSICS SECTION

The constitution of the atom: (*a*) *The planetary atom of the physicist:* S. J. M. Allen; (*b*) *Why not one kind of atom only?* R. C. Gowdy; (*c*) Discussion led by W. L. Evans.

PAPERS

The Arizona boll weevil (Anthonomus grandis var. thurberia) with special reference to steps taken by the Arizona Commission of Agriculture and Horticulture to prevent its establishment in cultivated cotton: Don C. Mote.

Aphelopus theliae (Gahan) and the changes produced in Thelia by this parasite: S. I. Kornhauser.

The intestinal parasites of overseas troops as compared with home service troops: S. I. Kornhauser.

A new disease, black tumor, of the catfish: R. C. Osburn.

Classification of the Opalinidae: Maynard M. Metcalf.

Geographical distribution of the Opalinidae: Maynard M. Metcalf.

Factors in the distribution of aquatic snails in Lake Erie: F. H. Krecker.

Caddis-fly larvae as agents in distribution of fresh water sponges: F. H. Krecker.

Notes on some tropical Homoptera: Herbert Osborn.

Generic and specific characters from the male genitalia of Syrphidae (Diptera): C. L. Metcalf.

Some myriapods of Put-in-Bay: Stephen R. Williams.

Claws of arachnids: W. M. Barrows.

The chondrocranium of Syngnathus fuscus: J. E. Kindred.

Additions to the birds of Ohio: Lynds Jones.

Bird migration groups: Lynds Jones.

Two recently destructive clover insects of western Ohio: T. H. Parks.

The preservation of native flora and fauna: Herbert Osborn.

New economic applications for the mangrove: H. H. M. Bowman.

The progress of revegetation in the Katmai district: Robert F. Griggs.

Observations on the edge of the forest in the Katmai district: Robert F. Griggs.

The influence of environment on sexual expression in the hemp: J. H. Schaffner.

A double mutant of the hemp: J. H. Schaffner.

Translocation and storage of carbohydrates in apple fruit spurs and two-year-old seedlings: Swarna Kumer Mitra.

Origin and character of schizogenous resin cavities in avocado fruits and leaves: Swarna Kumer Mitra.

Origin and character of adventitious roots in Cornus pubescence: Swarna Kumer Mitra.

Story of citrus fruits of Pinellas County, Florida: Katharine Dooris Sharp.

Factors controlling transpiration: Jasper D. Sayre.

Certain conditions that hinder the study of botany in high schools: Maximilian Braam.

Progress in plant microchemistry: H. C. Sampson.

Sugar syrup from home grown sugar beets: James R. Withrow.

Some farm experiments in the making of syrup from sugar beets: F. C. Vilbrandt.

Some pertinent questions for Ohio scientists: (a) Sulphuric acid and kiln plants and their fumes; (b) The errors of Ohio's legal kerosene flash point apparatus—the Foster cup; (c) The unnecessary use of potassium salts; (d) The damage to science and industry by the wastage of platinum: James R. Withrow.

Partial solution of certain applied chemical problems: (a) Saving of platinum by the use of platinum crucibles in electroanalysis; (b) By a modified mercury cathode cell; (c) The determination of water in substances easily decomposable thermally: James R. Withrow.

Gas combustion investigations: (a) Quartz-apparatus; (b) Central burner type; (c) Devitrification of quartz in capillaries: F. C. Vilbrandt.

The thermionic tube as a useful amplifying tool of the scientist: A. D. Cole.

A seasonal breakage of watch springs and its cause: Samuel R. Williams.

Springs of minimum weight: H. C. Lord.

Relations between atomic numbers and the wave lengths of X-rays: S. J. M. Allen.

Relations between absorption coefficients and wave lengths of X-rays: S. J. M. Allen.

Characteristic curves of different types of thermionic tubes: A. D. Cole.

Thermodynamics: Louis T. More.

Electrification by impact: Harold Richards.

On self and mutual elastance and capacitance: F. C. Blake.

Note on a double solenoid for the production of uniform magnetic fields: S. J. Barnett.

Observations on eruptive phenomena in the Valley of Ten Thousand Smokes: Robert F. Griggs.

Diastrophism still continuing in the Great Lakes region: E. L. Moseley.

Clarion and Vanport members in Ohio: Wilber Stout.

A pre-somite human embryo: C. L. Turner.

Relation of catalase to activity: R. J. Seymour.

Some features of industrial fatigue: E. R. Hayhurst.

Epidemic encephalitis: Ernest Scott.

Measurement of blood pressure by resistance of carbon discs: E. P. Durrant.

Educative characteristics of first grade children: Mary E. Miller.

A study of the lowest five per cent. of college students as determined by the army alpha examination: Helen Marshall.

A study of the highest five per cent. of college students as determined by the army alpha examinations: Earl R. Gabler.

Experimentation in the psychology of music: Esther L. Gatewood.

Mental and educational tests of the deaf: Jeannette Reamer.

Syphilis and delinquency: Florence Mateer.

DEMONSTRATIONS

Black tumor of the catfish: R. C. Osburn.

Some interesting tropical Hemiptera: Herbert Osborn.

Caddis cases covered with sponges: F. H. Krecker.

Wax models of 8 mm. and 12 mm. chondrocrania of *Syngnathus*: J. E. Kindred.

Models of pre-somite (Mateer) human embryo: C. L. Turner.

Specimens from the Valley of Ten Thousand Smokes: Robert F. Griggs.

Wireless telephone: R. A. Brown.

Edward L. Rice,
Secretary

Delaware, Ohio

SCIENCE

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